

WHAT IS CLAIMED IS:

1. A roadway paving apparatus for applying asphalt binder material and aggregate material to a ground surface, comprising:

a vehicle having an engine and wheels, the vehicle having opposed front and rear ends;

an aggregate material dispensing system carried by the vehicle, comprising:

(a) an input hopper disposed proximate the front end of the vehicle adapted to receive aggregate material;

(b) an output hopper disposed proximate the rear end of the vehicle, the output hopper converging toward a discharge port adapted to discharge aggregate material over the ground surface;

(c) a conveyor mechanism extending between the input hopper and the output hopper, the conveyor mechanism adapted to transport aggregate material from the input hopper to the output hopper;

an asphalt binder material dispensing system carried by the vehicle separate from the aggregate material system such that asphalt binder material and aggregate material are not mixed prior to aggregate material being dispensed through the discharge port, the asphalt binder material dispensing system comprising:

(a) a tank for holding asphalt binder material;

(b) a spray bar between the discharge port and the front end, the spray bar having a plurality of nozzles adapted to spray asphalt binder material; and

(c) a pump mechanism adapted to pump asphalt binder material from the tank to the spray bar; and

wherein all of the wheels roll on the ground surface between the spray bar and the front end such that no wheels roll over asphalt binder material and aggregate material that are discharged by the spray bar and through the output hopper.

2. The roadway paving apparatus of claim 1 wherein asphalt binder material and aggregate material are not mixed prior to application to the ground surface.

3. The roadway paving apparatus of claim 1 further comprising:
 an input conduit proximate the input hopper terminating in a hydraulic coupling, the hydraulic coupling adapted to connect to a supply of asphalt binder material; and
 an input asphalt pump connecting the input conduit to the tank for pumping asphalt binder material into the tank.

4. The roadway paving apparatus of claim 3 wherein the pump mechanism comprises an output asphalt pump interposed between the tank and the spray bar.

5. The roadway paving apparatus of claim 4 further comprising a swivel joint in the input conduit allowing rotation of the hydraulic coupling.

6. The roadway paving apparatus of claim 1 further comprising a mechanical coupling at the front end of the vehicle, the mechanical coupling adapted to selectively attach and detach from a supply truck carrying aggregate material for filling the input hopper.

7. The roadway paving apparatus of claim 1 further comprising at least one auger in the input hopper extending horizontally at locations above a front portion of the conveyor mechanism proximate the front end, the at least one auger arranged to spread out aggregate material received from the supply truck to increase effective holding capacity of the input hopper.

8. The roadway paving apparatus of claim 7 wherein the input hopper includes expansion wings at opposed sides of the input hopper for increasing holding capacity of the input hopper, the expansion wings pivoting from a lowered position wherein a first horizontal spacing is defined between the expansion wings to a raised transport position wherein a second horizontal spacing is defined between the expansion wings that is less than the first horizontal spacing sufficient to allow transportation within a single lane of a roadway.

9. The roadway paving apparatus of claim 1 further comprising: a plurality of control valves mounted to the spray bar, each control valve controlling flow of asphalt binder material to at least one of the nozzles, the control valves having open and closed states for allowing and preventing flow of asphalt binder material to individual nozzles.

10. The roadway paving apparatus of claim 9 further comprising:
a plurality of gates dividing the discharge port into a plurality of sections, the gates having open and closed states for allowing and preventing discharge of aggregate material; and further comprising:

a controller controlling the opening and closing of the control valves and the gates setting an application width for asphalt binder material and aggregate material.

11. The roadway paving apparatus of claim 10 wherein the conveyor mechanism comprises first and second endless belt conveyors, and wherein the output hopper comprises first and second dispensing bins, further comprising a chute, the first and second endless belt conveyors extending diagonally and vertically upward from the front end toward the rear end outputting aggregate material through the chute, the chute guiding aggregate material into the first and second bins, the bins being horizontally movable expanding and contracting the discharge port between minimum and maximum application widths for the discharge port.

12. The roadway paving apparatus of claim 11 further comprising extendible and retractable arms on the spray bar extending the spray bar substantially equivalent to the maximum application width.

13. The roadway paving apparatus of claim 1 wherein the spray bar is generally parallel to the discharge port and spaced in front of the discharge port between about 0.1 and about 10 feet.

14. The roadway paving apparatus of claim 1 wherein the roadway paving apparatus applies asphalt binder material and aggregate material at a maximum speed of between about 1 and about 15 miles per hour.

15. A method of chipsealing a roadway surface with a roadway paving vehicle, the roadway paving vehicle comprising a front end and a rear end, the method comprising:

storing a supply of asphalt binder material in a tank on the roadway paving vehicle;

transporting asphalt binder material from the tank to a spray bar at the rear end of the roadway paving vehicle;

spraying asphalt binder material from the spray bar at a first span over the roadway surface forming a layer of asphalt binder material on the roadway surface;

storing a supply of aggregate material in an input hopper at the front end of the roadway paving vehicle;

transporting aggregate material from the input hopper to an output hopper at the rear end of the roadway paving vehicle;

discharging aggregate material from the output hopper at a second span over the layer of asphalt binder material; and

preventing intermixing of asphalt binder material and aggregate material prior to the discharging of aggregate material and spraying of asphalt binder material.

16. The method of claim 15 further comprising:
providing a supply truck;

linking the front end of the roadway paving vehicle with the supply truck so that the supply truck and the roadway paving vehicle travel forward in unison, the supply truck including a supply tank of asphalt binder material and an elongate supply hopper of aggregate material; and

refilling the tank with asphalt binder material and the input hopper with aggregate material wherein refilling is completed without stopping the roadway paving vehicle.

17. The method of claim 16 further comprising:

mobilizing aggregate material from the supply truck to refill the input hopper of the roadway paving vehicle via a live bottom conveyor on the supply truck; and

controlling the live bottom conveyor via a control module at an operator station on the roadway paving vehicle to selectively control refilling of the input hopper.

18. The method of claim 17 wherein supply truck includes a tailgate, further comprising:

extending the control module from the supply truck to the operator station by opening the tailgate, the control module being supported by the tailgate.

19. The method of claim 18 wherein the supply truck includes a tailgate controlling discharge of aggregate material into the input hopper, further comprising:

extending a transfer conduit from the supply truck to an operator station on the roadway paving vehicle; and

hooking the transfer conduit into a input conduit at the operator station to transfer asphalt binder material into the tank.

20. The method of claim 19 further comprising pumping asphalt binder material into the tank via an input pump mounted on the roadway paving vehicle.

21. The method of claim 15 further comprising:

selectively controlling valves on the spray bar to vary the first span and set a selected length of the first span; and

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a support arm mounted to the tailgate, the support arm supporting the transfer conduit and guiding rearward extension of the transfer conduit and hydraulic coupling.

28. The supply truck of claim 27 further comprising:
a control module supported by the support arm and electronically connected to the conveyor mechanism, the control module controlling operation of the conveyor mechanism to control discharge of material from the hopper.

29. The supply truck of claim 28 wherein the tailgate comprises a pair of doors, the doors being pivotably mounted to the hopper such that the doors pivot horizontally outwardly away from each other to open the discharge region and inwardly toward each other to close the discharge region, the support arm being mounted to one of the doors.

30. The supply truck of claim 29 wherein the support arm extends diagonally between vertical and horizontal axes and extends vertically above a vertical top edge of the doors, the control module and hydraulic coupling arranged on the support arm such that the control module and hydraulic coupling extend horizontally rearwardly substantially beyond the doors when the doors are open sufficient to avoid interference with material discharged through the discharge region when the conveyor mechanism is operating.

31. The supply truck of claim 30 further comprising:
means for securing the transfer conduit to the support arm.

32. The supply truck of claim 29 further comprising:
fluid powered cylinders mounted to the hopper controlling the opening and closing of the doors.

33. The supply truck of claim 26 wherein the supply truck is linked to a roadway paving vehicle, the roadway paving vehicle including an operator station, an asphalt binder material dispensing system and an aggregate material dispensing system, the asphalt binder material dispensing system including an asphalt tank and an input conduit connected to the asphalt tank, the input conduit having a hydraulic coupling at the operator station, the hydraulic coupling of the input conduit connecting to the hydraulic coupling of the transfer conduit.

34. The supply truck of claim 26 wherein the supply truck includes front wheels and rear wheel sets, the supply tank being mounted beneath the conveyor mechanism and the hopper and between the front wheel set and the rear wheel set, whereby a low center of gravity is provided when the tank is filled with liquid.

35. A supply truck, comprising:

a chassis supported on front wheels and rear wheel sets, the chassis extending between front and rear ends;

a supply hopper supported by the chassis having a discharge region at the rear end;

a conveyor mechanism in the supply hopper adapted to convey aggregate material toward the discharge region;

a tailgate closing the discharge region of the supply hopper, the tailgate moving rearwardly relative to the chassis to open the discharge region to allow discharge of aggregate material from the rear end of the supply truck;

a supply tank carrying asphalt binder material, the supply tank being disposed beneath the conveyor mechanism and the hopper and between the front wheel set and the rear wheel set, whereby a low center of gravity is provided when the tank is filled with liquid; and

a transfer conduit connected to the supply tank, the transfer conduit including a hydraulic coupling.

36. The supply truck of claim 35 wherein the transfer conduit extends rearwardly toward the rear end supported by the supply hopper.

37. The supply truck of claim 35 wherein the supply tank includes a top end mounted to the chassis.

38. A method of chipsealing a roadway surface using a roadway paving vehicle having wheels, comprising:

spraying asphalt binder material from the roadway paving vehicle over a roadway surface forming a layer of asphalt binder material on the roadway surface;

discharging aggregate material from the roadway paving vehicle over the layer of asphalt binder material;

preventing intermixing of asphalt binder material and aggregate material prior to the application of aggregate material and spraying of asphalt binder material to the roadway surface; and

insuring that no wheels of the roadway paving vehicle roll over the asphalt binder material or aggregate material after they are discharged onto the roadway.

39. The method of claim 38 further comprising:

linking the roadway paving vehicle with a supply truck while continuing the spraying of asphalt binder material and discharging aggregate material with the supply truck

and the roadway paving vehicle traveling forward in unison, the supply truck including a supply of asphalt binder material and a supply of aggregate material; and

transferring the supply of asphalt binder material and the supply of aggregate material from the supply truck to the roadway paving vehicle.

40. The method of claim 39 further comprising controlling the transferring of the supply of asphalt binder material and the supply of aggregate material to the roadway paving vehicle at an operator station on the roadway paving vehicle.

41. The method of claim 39 further comprising:
 unlinking the roadway paving vehicle and a supply truck while continuing the spraying of asphalt binder material and discharging aggregate material; and
 linking the roadway paving vehicle with a second supply truck while continuing the spraying of asphalt binder material and discharging aggregate material with the second supply truck and the roadway paving vehicle traveling forward in unison, the second supply truck including a supply of asphalt binder material and a supply of aggregate material; and
 transferring the supply of asphalt binder material and the supply of aggregate material from the second supply truck to the roadway paving vehicle.

42. The method of claim 38 further comprising:
 selectively controlling the spraying to set a first span of a first length over which asphalt binder material is sprayed; and
 selectively controlling the discharging to set a second span of a second length over which aggregate material is discharged.

43. The method of claim 42 further comprising:
 varying the lengths of the first and second spans in substantial unison such that substantially all asphalt binder material is covered with aggregate material.

44. The method of claim 38 further comprising:
 supporting the entire roadway paving vehicle with wheels disposed entirely in front of the spraying of asphalt binder material and discharging of aggregate material such that no wheels roll over sprayed asphalt binder material or discharged aggregate material.

45. The method of claim 38 wherein the discharging of aggregate material and the spraying of asphalt binder material are spaced between about 0.1 and about 10 feet.

46. The method of claim 38 wherein the roadway paving apparatus sprays asphalt binder material and discharges aggregate material at a maximum speed of between about 1 and about 15 miles per hour.

47. A roadway paving system for chipsealing a roadway surface, comprising:

a roadway paving vehicle comprising an asphalt binder material dispensing system and an aggregate material dispensing system, the asphalt binder material dispensing system including an asphalt tank containing a first supply of asphalt binder material and a sprayer spraying a first layer of the spray asphalt binder material over the roadway surface, the aggregate material dispensing system holding a first supply of aggregate material and discharging a second layer of aggregate material over the roadway surface over the first layer, the asphalt binder material dispensing system being separate from the aggregate material system such that asphalt binder material and aggregate material are not mixed prior to aggregate material being dispensed;

at least two supply trucks, each supply truck comprising a supply hopper containing a second supply of aggregate material and supply tank containing a second supply of asphalt binder material;

a link between a first one of the supply trucks and the roadway paving vehicle including a transfer conduit transferring asphalt binder material from the supply tank to the asphalt tank, and wherein aggregate material is transferred from the supply hopper to the aggregate dispensing system; and

wherein the asphalt tank and aggregate material dispensing system have a sufficient holding capacity such that said first one of the supply trucks may be unlinked from the roadway paving vehicle and a second one of the supply trucks may be linked to the roadway paving vehicle with continuous application of asphalt binder material and aggregate material without stopping the roadway paving vehicle.

48. The roadway paving system of claim 47, wherein the aggregate material dispensing system includes an input hopper disposed proximate a front end of the vehicle adapted to receive aggregate material and an output hopper disposed proximate a rear end of the vehicle, the output hopper converging toward a discharge port discharging aggregate material over the roadway surface, the aggregate dispensing system further comprising a conveyor mechanism extending between the input hopper and the output hopper, the conveyor transporting aggregate material from the input hopper to the output hopper.

49. The roadway paving system of claim 47, wherein the sprayer comprises a spray bar, a plurality of nozzles spraying asphalt binder material, and a pump for pumping asphalt binder material from the asphalt tank to the spray bar.

50. The roadway paving system of claim 47, wherein the roadway paving vehicle includes a plurality of wheels for support, all of the wheels rolling on the roadway surface in front of the first and second layers such that no wheels roll over asphalt binder material and aggregate material that have been applied to the roadway surface.

51. The roadway paving system of claim 47 wherein the roadway paving vehicle further comprises:
an operator station adapted to support an operator; and
an input conduit fluidically connected to the transfer conduit through a detachable hydraulic coupling at the operator station.

52. The roadway paving system of claim 51 wherein the input conduit comprises a swivel joint allowing rotation of hydraulic coupling.

53. The roadway paving system of claim 47 wherein the spraying of asphalt binder material and the discharging of aggregate material are spaced horizontally between about 0.1 and about 10 feet.

54. The roadway paving system of claim 47 wherein the roadway paving apparatus applies the first and second layers of asphalt binder material and aggregate material at a maximum speed of between about 1 and about 15 miles per hour.

55. The roadway paving system of claim 48 wherein the supply truck comprises a conveyor mechanism in the supply hopper adapted to convey aggregate material into the input hopper of the roadway paving vehicle, and further comprising a control module adapted to be operated at a location on the roadway paving vehicle for use by an operator on the roadway paving vehicle, the control module controlling the conveyor mechanism.

56. The roadway paving system of claim 47 wherein the supply truck includes a tailgate closing a discharge region of the supply hopper, the tailgate moving toward the roadway paving vehicle to open the discharge region to allow discharge of aggregate material from a rear end of the supply truck, the transfer conduit being carried by

the tailgate and connected to the supply tank, the transfer conduit and hydraulic coupling extending with the tailgate for connection when the tailgate moves towards the roadway paving vehicle.

57. The roadway paving system of claim 56 further comprising a support arm mounted to the tailgate, the support arm supporting the transfer conduit.

58. The roadway paving system of claim 57 wherein the supply truck comprises a conveyor mechanism in the supply hopper adapted to convey aggregate material into aggregate hopper, further comprising a control module supported by the support arm and electronically connected to the conveyor mechanism, the control module controlling operation of the conveyor mechanism to control discharge of material from the hopper.

59. The roadway paving system of claim 57 wherein the tailgate comprises a pair of doors, the doors being pivotably mounted to the hopper such that the doors pivot horizontally outwardly away from each other to open the discharge region and inwardly toward each other to close the discharge region, the support arm being mounted to one of the doors.

60. A roadway paving apparatus for applying asphalt binder material and aggregate material to a ground surface, comprising:

a vehicle having an engine and wheels, the vehicle having opposed front and rear ends;

an aggregate material dispensing system carried by the vehicle adapted to hold a supply of aggregate material and having a discharge port proximate the rear end of the vehicle behind the wheels, the discharge port adapted to discharge aggregate material over the ground surface, the aggregate material dispensing system including a conveyor mechanism extending substantially between the front and rear ends for transporting aggregate material rearwardly toward the discharge port;

an asphalt binder material dispensing system carried by the vehicle separate from the aggregate material system such that asphalt binder material and aggregate material are not mixed prior to aggregate material being dispensed through the discharge port, the asphalt binder material dispensing system adapted to hold a supply of asphalt binder material, the asphalt binder material dispensing system including a sprayer having a spray bar with a plurality of nozzles, the spray bar adapted to spray asphalt binder material through the nozzles behind the wheels; and

~~discharged by the spray bar and through the output hopper.~~

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67. The roadway paving apparatus of claim 62 further comprising at least one auger in the input hopper extending horizontally at locations above a front portion of the conveyor mechanism proximate the front end, the at least one auger arranged to spread out aggregate material received from the supply truck to increase effective holding capacity of the input hopper.

Table 1

Year	Age	Sex	Weight (kg)	Height (cm)	BMI (kg/m ²)	Waist circumference (cm)	Hip circumference (cm)	Body fat (%)	Visceral fat (cm ³)	Skeletal muscle mass (kg)	Cardiac mass (g)	Liver mass (g)	Kidney mass (g)	Pancreas mass (g)	Gallbladder mass (g)	Spleen mass (g)	Stomach mass (g)	Intestine mass (g)	Total body mass (kg)	
1980	20	M	65	175	21.1	85	95	15	100	55	150	150	150	150	150	150	150	150	150	65
1985	25	F	55	165	20.1	75	85	15	100	50	140	140	140	140	140	140	140	140	140	55
1990	30	M	70	180	22.2	90	100	15	100	60	160	160	160	160	160	160	160	160	160	70
1995	35	F	60	170	20.7	80	90	15	100	55	150	150	150	150	150	150	150	150	150	60
2000	40	M	75	185	21.6	95	105	15	100	65	170	170	170	170	170	170	170	170	170	75
2005	45	F	65	175	21.1	85	95	15	100	60	160	160	160	160	160	160	160	160	160	65
2010	50	M	80	190	22.6	100	110	15	100	70	180	180	180	180	180	180	180	180	180	80
2015	55	F	70	180	22.2	90	100	15	100	65	170	170	170	170	170	170	170	170	170	70
2020	60	M	85	195	22.6	105	115	15	100	75	190	190	190	190	190	190	190	190	190	85
2025	65	F	75	185	21.6	95	105	15	100	70	180	180	180	180	180	180	180	180	180	75
2030	70	M	90	200	22.5	110	120	15	100	80	200	200	200	200	200	200	200	200	200	90
2035	75	F	80	190	22.6	100	110	15	100	75	190	190	190	190	190	190	190	190	190	80
2040	80	M	95	205	23.0	115	125	15	100	85	210	210	210	210	210	210	210	210	210	95
2045	85	F	85	195	23.0	105	115	15	100	80	200	200	200	200	200	200	200	200	200	85
2050	90	M	100	210	23.0	120	130	15	100	90	220	220	220	220	220	220	220	220	220	100
2055	95	F	90	200	22.5	110	120	15	100	85	210	210	210	210	210	210	210	210	210	90
2060	100	M	105	215	23.0	125	135	15	100	95	230	230	230	230	230	230	230	230	230	105
2065	105	F	95	205	23.0	115	125	15	100	90	220	220	220	220	220	220	220	220	220	95
2070	110	M	110	220	23.0	130	140	15	100	100	240	240	240	240	240	240	240	240	240	110
2075	115	F	100	210	23.0	120	130	15	100	95	230	230	230	230	230	230	230	230	230	100
2080	120	M	115	225	23.0	135	145	15	100	105	250	250	250	250	250	250	250	250	250	115
2085	125	F	105	215	23.0	125	135	15	100	100	240	240	240	240	240	240	240	240	240	105
2090	130	M	120	230	23.0	140	150	15	100	110	260	260	260	260	260	260	260	260	260	120
2095	135	F	110	220																

70. The roadway paving apparatus of claim 69 further comprising:
a plurality of gates dividing the discharge port into a plurality of sections, the
gates having open and closed states for allowing and preventing discharge of aggregate
material; and further comprising:

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